

WHAT IS CLAIMED IS:

- 1    1.     An integrated circuit comprising:  
2            an active termination circuit having first and second transistors of opposite type coupled  
3    in series between a Vdd node of a first source potential and a Vss node of a second source  
4    potential, the second source potential being lower than the first source potential, the at least one  
5    termination node being coupled to a common node between the first and second transistors; and  
6            a control circuit operable to bias the first and second transistors.
- 1    2.     The integrated circuit as in claim 1 wherein the control circuit is operable to bias the first  
2    and second transistors such that they provide a clamping function at the common node.
- 1    3.     The integrated circuit of claim 1 wherein the first transistor is a MOSFET of the N-  
2    channel type and the second transistor is a MOSFET of the P-channel type;  
3            the drain of the first MOSFET is coupled to the Vdd node, and the drain of the second  
4    MOSFET is coupled to the Vss node; and  
5            the sources of both MOSFETs are coupled together and to the common node.
- 1    4.     The integrated circuit of claim 1 wherein:  
2            the control circuit includes a first control terminal control circuit operable to provide  
3    a first control terminal drive signal to a control terminal of the first transistor, and a second  
4    control terminal control circuit operable to provide a second control terminal drive signal to a  
5    control terminal of the second transistor; and  
6            the first and second control terminal drive signals are such that a quiescent voltage  
7    potential of the common node is between the Vdd and Vss potentials.

1 5. The integrated circuit of claim 4 wherein the quiescent voltage potential of the  
2 common node is at about a midpoint between the Vdd and Vss potentials.

1 6. The integrated circuit of claim 4 wherein the first and second control terminal control  
2 circuits are operable to provide a first control terminal drive signal to a control terminal of  
3 the first transistor and a second control terminal drive signal to a control terminal of the  
4 second transistor to control the quiescent switch current through the first and second  
5 transistors.

1 7. The integrated circuit of claim 4 wherein the first control terminal drive signal to a  
2 control terminal of the first transistor and the second control terminal drive signal to a control  
3 terminal of the second transistor are preferably controlled such that the quiescent current  
4 conducted through the switch is substantially less than the current through two resistors whose  
5 parallel resistance approximates the characteristic impedance of a coupled transmission line.

1 8. The integrated circuit of claim 4 wherein the device geometries, device size, and  
2 processing of the first and second transistors are scaled so that they achieve a controlled  
3 impedance and a quiescent voltage potential at the common node in response to an induced  
4 voltages produced by the driver circuit coupling communication signals to the termination  
5 node, and the quiescent voltage potential is at about a midpoint between the Vdd and Vss  
6 potentials.

1 9. The integrated circuit of claim 4 wherein the first and second control terminal control  
2 circuits are operable from voltage sources that are greater than the source potential Vdd for the  
3 first control terminal control circuit, and less than the source potential Vss for the second

4 control terminal control circuit, and are capable of providing control terminal control signals,  
5 respectively, that are greater than the source potential  $V_{dd}$  and less than the source potential  $V_{ss}$ .

1 10. The integrated circuit of claim 1 and further comprising:  
2 a third transistor having a current path and a control terminal, the current path coupled  
3 between the first transistor and the voltage source  $V_{dd}$ ; and  
4 a fourth transistor, having a current path and a control terminal, the current path coupled  
5 between the second transistor and the voltage source  $V_{ss}$  wherein the operation of the first and  
6 second transistors can be selectively enabled or disabled by control signals coupled to the control  
7 terminals of the third and fourth transistors.

1 11. The integrated circuit of claim 10 wherein the third transistor is a P-channel MOSFET  
2 and the fourth transistor is an N-channel MOSFET.

1 12. The integrated circuit of claim 1 wherein the control terminal control circuit preferably  
2 includes a fifth transistor and a sixth transistor in series across a  $V_{dd}$  node of a first source  
3 potential and a  $V_{ss}$  node of a second source potential and scaled to the first and second  
4 transistors; and  
5 a current source coupled to at least one of the fifth or sixth transistor that controls the  
6 quiescent current level in the first and second transistors.

1 13. The integrated circuit of claim 12 wherein the fifth transistor is an N-channel MOSFET,  
2 and the sixth transistor is a P-channel MOSFET.

1 14. The integrated circuit of claim 1 wherein the control circuit preferably includes a voltage  
2 source operable to produce a voltage potential of about a midpoint of the voltages of the voltage  
3 sources Vdd and Vss.

1 15. The integrated circuit of claim 1 wherein the control circuit preferably includes a voltage  
2 source operable to produce a voltage potential responsive to an externally supplied input voltage.

1 16. The integrated circuit of claim 1 and further comprising a resistor coupled between  
2 the common node and the termination node.

1 17. An active termination circuit, comprising:  
2 a first MOSFET having a gate terminal, a drain terminal, and a source terminal, the  
3 source terminal coupled to a common node, and the drain terminal coupled to a Vdd node of  
4 a first source potential;  
5 a second MOSFET having a gate terminal, a drain terminal, and a source terminal, the  
6 source terminal coupled to the common node, and the drain terminal coupled to a Vss node  
7 of a second source potential, the second source potential being lower than the first source  
8 potential; and  
9 a control circuit operable to bias the first and second MOSFETs.

1 18. The active termination circuit of claim 17 wherein the control circuit operates to bias the  
2 first and second MOSFETs such that they exhibit a controlled impedance at the common node.

1 19. The active termination circuit of claim 17, wherein the first MOSFET is an N-channel  
2 MOSFET and the second MOSFET is a P-channel MOSFET.

1 20. The active termination circuit of claim 17, wherein the gate of the first MOSFET is  
2 coupled to a voltage source between the Vdd and Vss potentials and the gate of the second  
3 MOSFET is coupled to another voltage source of a lower potential.

1 21. The active termination circuit of claim 20, wherein the potential difference between the  
2 voltage sources coupled to the gates of the first and second MOSFETs is controlled by a current  
3 source.

1 22. The active termination circuit of claim 17 wherein the control circuit comprises:  
2 a first operational amplifier with an output coupled to the gate terminal of the first  
3 MOSFET; and  
4 a second operation amplifier with an output coupled to the gate terminal of the second  
5 MOSFET.

1 23. The active termination circuit of claim 22 wherein the first MOSFET is an N-channel  
2 MOSFET and the second MOSFET is a P-channel MOSFET and wherein the first operational  
3 amplifier is powered by a power supply potential greater than Vdd and the second operational  
4 amplifier is powered by a power supply potential less than Vss, the first and second operational  
5 amplifiers capable of producing gate drive signals greater than the power supply potential Vdd  
6 and less than the power supply potential Vss, respectively.

1 24. The active termination circuit of claim 23 and further comprising:  
2 a third MOSFET with a channel coupled between Vdd and the first operational amplifier,  
3 the third MOSFET having a gate terminal coupled to the gate terminal of the first MOSFET, the  
4 third MOSFET being an N-channel MOSFET; and

5 a fourth MOSFET with a channel coupled between Vss and the first operational  
6 amplifier, the fourth MOSFET having a gate terminal coupled to the gate terminal of the second  
7 MOSFET, the fourth MOSFET being a P-channel MOSFET.

1 25. The active termination circuit of claim 17 and further comprising a first enable switch  
2 coupled between the first MOSFET and Vdd and a second enable switch coupled between the  
3 second MOSFET and Vss.

1 26. An active termination circuit, comprising:

2 a first bipolar transistor having a base terminal, a collector terminal, and an emitter  
3 terminal, the emitter terminal coupled to a common node, and the collector terminal coupled  
4 to a Vdd node of a first source potential;

5 a second bipolar transistor having a base terminal, a collector terminal, and a emitter  
6 terminal, the emitter terminal coupled to the common node, and the emitter terminal coupled  
7 to a Vss node of a second source potential, the second source potential being lower than the  
8 first source potential; and

9 a control circuit operable to bias the first and second bipolar transistors such that they  
10 exhibit a controlled impedance at the common node.

1 27. A method of operating an active termination circuit, the method comprising:

2 biasing first and second series coupled transistors of opposite type such that they exhibit a  
3 controlled impedance at a common node thereof, wherein the first and second transistors are  
4 coupled in series across a Vdd node of a first source potential and a Vss node of a second source  
5 potential, the common node being between the first and second transistors , and the second  
6 source potential being lower than the first source potential.

1 28. The method of claim 27 wherein biasing first and second series coupled transistors  
2 comprises producing first and second control terminal drive signals and applying said first and  
3 second control terminal drive signal to the first and second series coupled transistors, the first  
4 and second control terminal drive signals produced such that a quiescent voltage potential of the  
5 common node is between the Vdd and Vss potentials.

1 29. The method of claim 28 wherein the first and second series coupled transistors are  
2 MOSFETs.

1 30. The method of claim 27 wherein the quiescent voltage potential of the common node  
2 is produced at about a midpoint between the Vdd and Vss potentials.

1 31. The method of claim 27 and further comprising scaling device geometries, device  
2 size, and processing of the first and second MOSFETs so that their coupled sources produce  
3 a controlled impedance and a quiescent voltage potential at the common node in response to  
4 an induced voltages produced by the driver circuit coupling communication signals to the  
5 termination node.